Spectrum Efficiency Research

Outputs

- Report on Federal LMR systems in the Washington, DC, area.
- White paper on spectrum efficiency concepts.
- Consultation with OSM on spectrum efficiency planning.

NTIA is deeply committed to an extensive multi-pronged program to improve the spectrum efficiency of Federal radio systems. This program was given additional importance by the May 2003 announcement of a November 30 Presidential Spectrum Policy Initiative to promote the development and implementation of a U.S. spectrum management policy for the 21st century. More recently, the NTIA administrator, Michael Gallagher, announced a multi-year effort to carry out a series of spectrum efficiency directives contained in a November 2004 Presidential Memorandum to multiple Federal departments. Although most of this work will be accomplished by NTIA's Office of Spectrum Management (OSM) in Washington, ITS is also playing a key role in several aspects of this work.

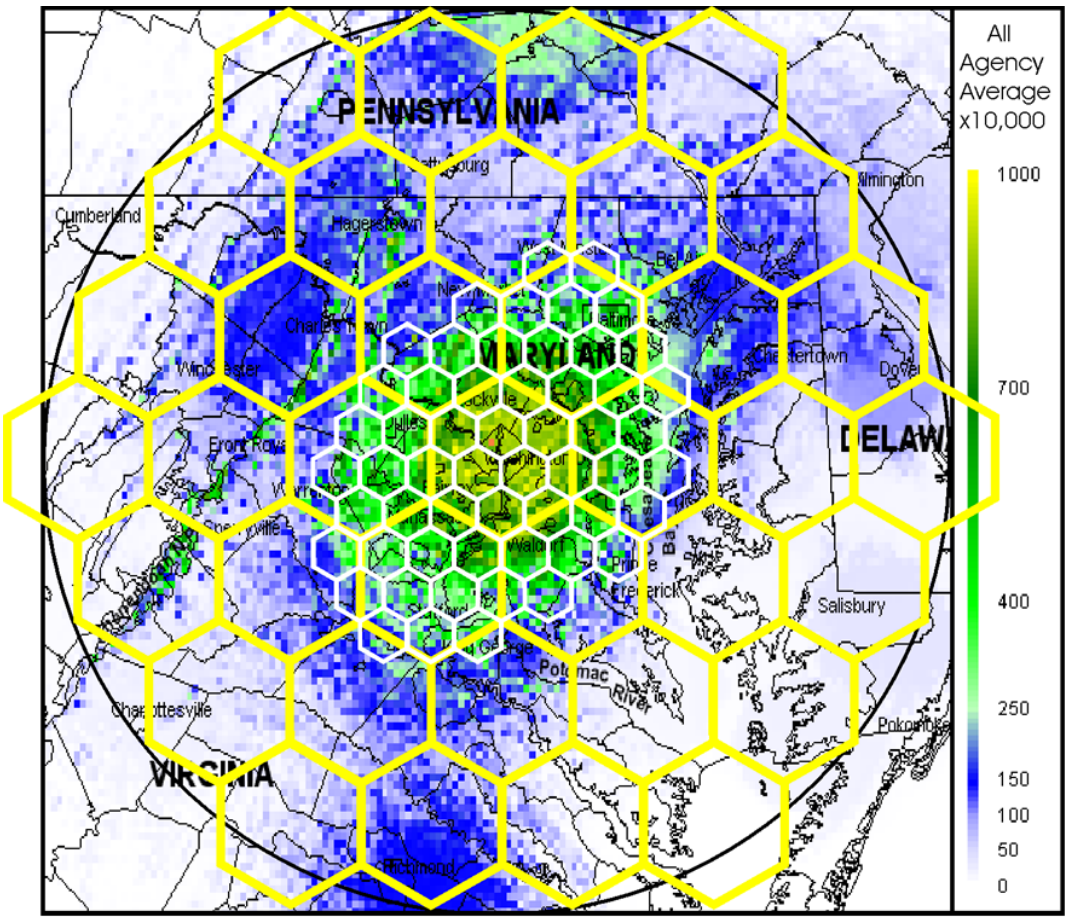
ITS is working with OSM to develop theoretical concepts and practical applications of improved spectrum efficiency. A problem is that "spectrum efficiency" can mean many things — some of them contradictory — and ITS has been active in helping to sort out concepts that will be useful in guiding Federal policies toward more effective use of the radio spectrum. During FY 2004, ITS prepared an initial paper on Spectrum Efficiency Concepts to guide discussion on some of the problematic aspects of spectrum efficiency that needed to be resolved to help NTIA develop improved policies and practices.

In related work, ITS is currently examining possible metrics (i.e., equations) that describe the spectrum efficiency of several types of radio services. This work will serve partly as a "reality check" to show whether it is practical to routinely and rigorously compute the spectrum efficiency of existing or proposed Federal radio systems.

ITS has been assisting in a modeling effort to see whether the current myriad of single-agency Federal mobile radio systems in the Washington, DC, area could be efficiently replaced by one large shared trunked radio system. The first part of this work was completed last year, including an NTIA Report (see Recent Publications below). This work investigated the current Federal land mobile radio (LMR) systems in the vicinity of Washington, DC. A major part of this study was to develop a signal capacity (SC) model that counted the number of independent radio signals available to a mobile user on a geographical basis, using the Government Master File (GMF) of Federal radio licenses as a source of detailed data. The SC model was developed to provide a combined geographical coverage "footprint" of the multiple independent existing radio systems now serving Federal Agencies. The SC model showed that as many as 268 separate LMR radio channels were available to a mobile user in the downtown Washington area in the 162-174 MHz band, as well as summarizing the current geographical coverage that a future shared trunked system would need to duplicate.

The other major input to a model for the design of future LMR systems was the measurement of actual LMR traffic (Erlangs) in the Washington area, using the ITS Radio Spectrum Measurement System (RSMS). These measurements were completed in November 2004, and the results will be used to describe the total amount of traffic that a future shared radio system should be designed to handle.

The design of future alternative shared LMR systems will be based on the SC geographical coverage data and the RSMS measured traffic data. The figure shows the average signal capacity (ASC) map for Washington, DC, overlaid with a 100-mi radius circle. The ASC map shows the number of independent radio systems per square mile (actual ACS values are multiplied by 10,000 on the map). This ASC data will be used to design several generic types of trunked radio systems, whose 20-mi radius coverage areas are shown as the large yellow hexagons. Two other generic trunked systems will use a combination of large-coverage cells in the outlying areas and two sizes of small-coverage cells (smaller white



Average signal capacity map for all Federal agencies within 100 miles of Washington, DC, overlaid with generic mobile radio base station coverage areas.

hexagons) in the central metropolitan areas. These three generic designs will be evaluated using four assumptions about the total number of users participating in the shared system, including traffic levels equivalent to 30%, 100%, 300%, and 1000% of the current RSMS-measured traffic levels. The final report is expected to evaluate each of the three system architectures under the conditions of the four traffic loading assumptions. These studies will provide useful insights for how the advantages of large shared trunked systems would be expected to scale for a range of alternative system architectures and operational scenarios.

Recent Publications & Presentations

G. Patrick, et al., "Spectrum effectiveness initiative: Phase 1 — Study of Federal operations in the 162-174 MHz band in the Washington, DC area," NTIA Report 04-415, in progress.

G. Patrick, C. Hoffman, and R. Matheson, "Signal capacity modeling for shared radio system planning," in "Proceedings of the International Symposium on Advanced Radio Technologies: March 2-4, 2004," J.W. Allen, T.X Brown, D.C. Sicker, and J. Ratzloff (Eds.), NTIA Special Publication SP-04-409, Mar. 2004, pp 77-86.

R. Matheson, "Alternative spectrum management techniques," tutorial presented at the International Symposium on Advanced Radio Technologies, Mar. 2004.

R. Matheson, "Spectrum measurements," invited presentation at the National Academy of Sciences, Committee on Wireless Technology Prospects and Policy Options, San Diego, Jul. 22, 2004.

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